

IN THE CLAIMS:

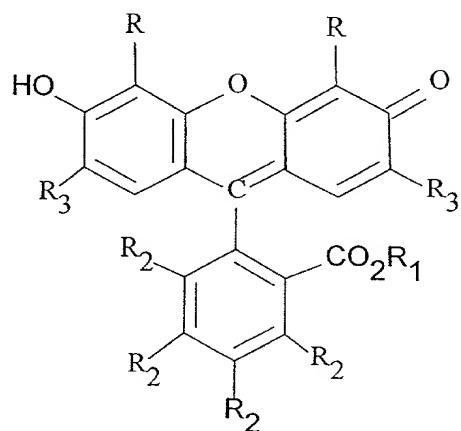
1. A luminescent material for an optical memory device comprising a substitute, insoluble microparticles dispersed in a water soluble polymer, said microparticles having a particle size less than about 0.2 microns, said microparticle, having a sorbed luminescent dye wherein said water soluble polymer and dispersed microparticles are applied to a substrate.

2. The microparticle material of claim 1, wherein the insoluble microparticles comprise silver microparticles, and insoluble metal salts.

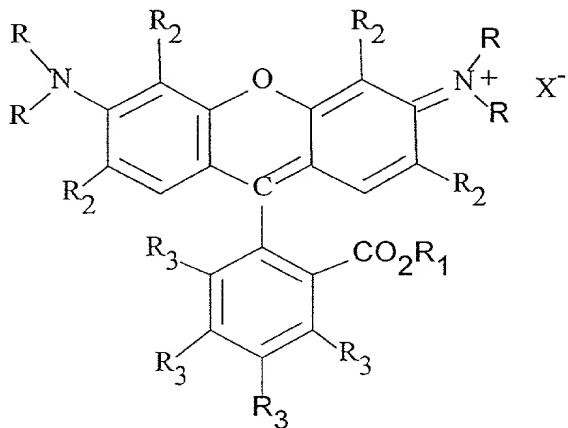
3. The microparticles material of claim 1 wherein the water soluble polymer is selected from:

4. The microparticle material of claim 1, wherein the luminescent dye is selected from the group consisting of:

the xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of the following structure:

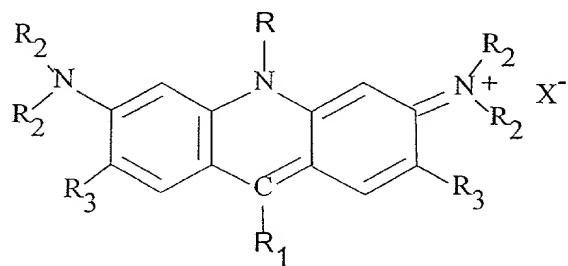


wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl and others; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate, alkyl and others; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub>, alkyl and others; the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

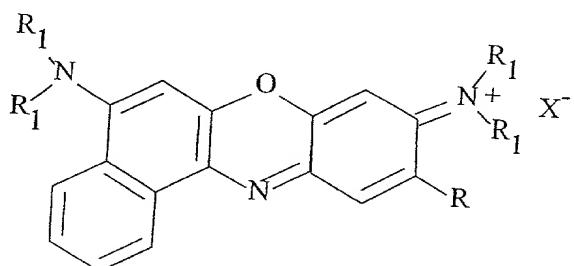
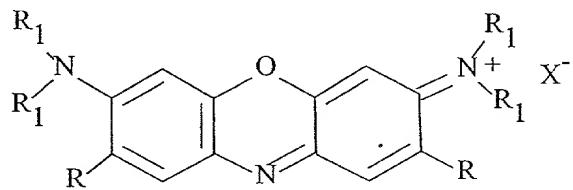
the acridine dyes, including aurazine, trypanoflovine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is

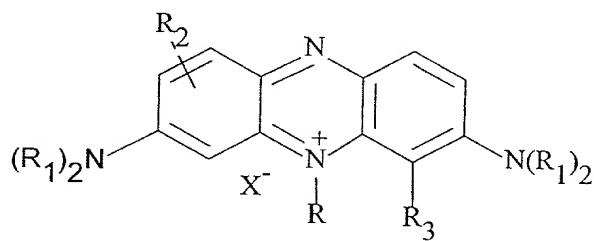
independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub>, alkyl and others; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



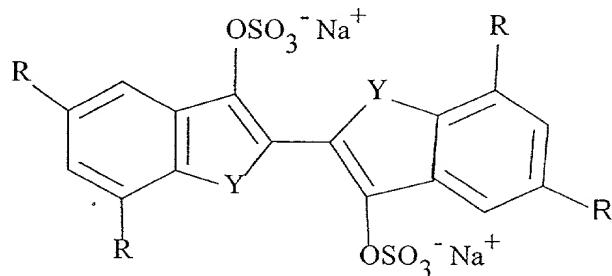
where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub> and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

the azine dyes, including magdala red, lactoflavine. and others having the following structure:



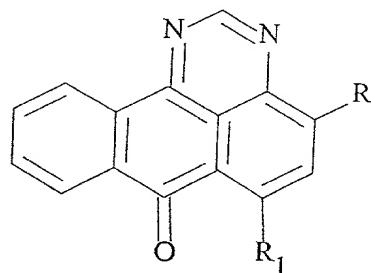
wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl; R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

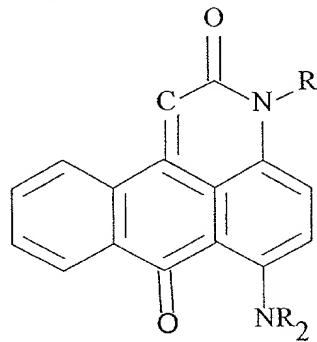


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

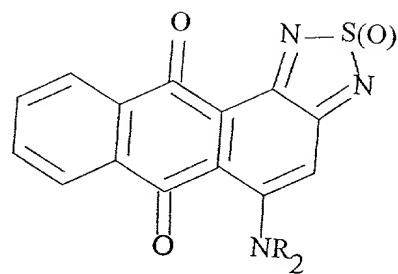
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoantroquinones, dyes from the group of benzanthrone in the form of sulfuric esters of leuco compounds having the following structures:



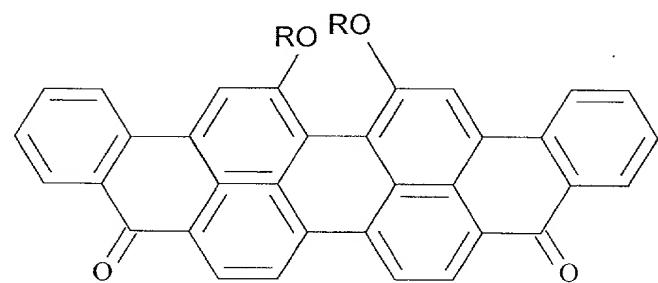
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



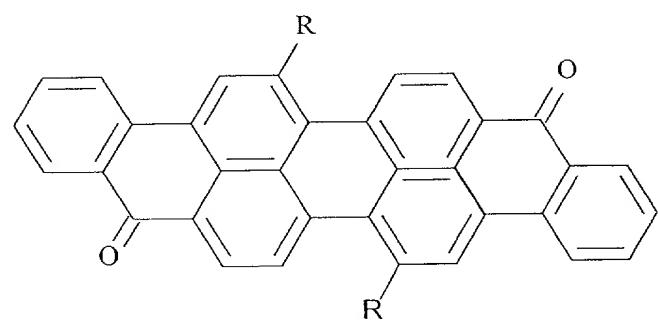
where R is H, alkyl, or aromatic,



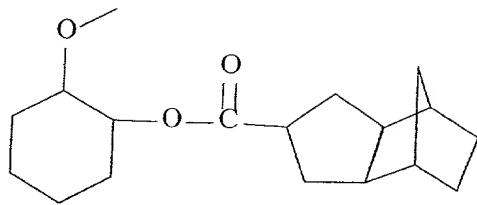
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



where R is H, Ar, -SO<sub>2</sub>Ar and others,

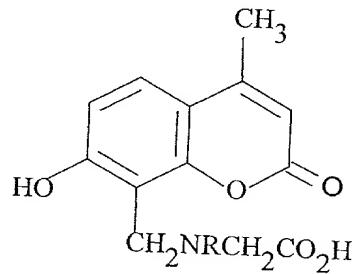
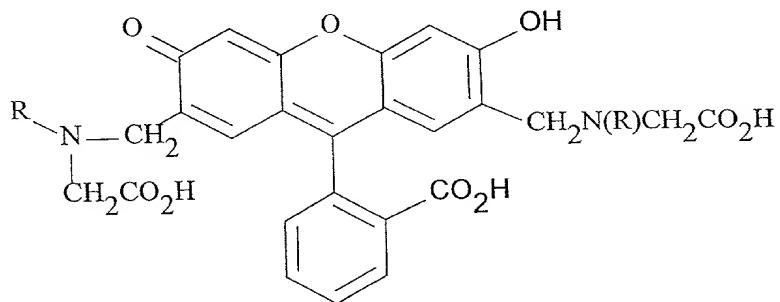


where R is independently selected from H, Cl, Br, OH, the structure:

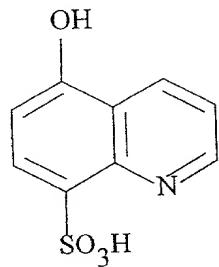
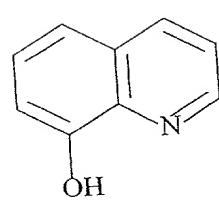
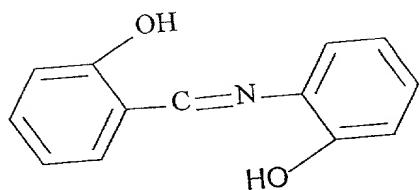
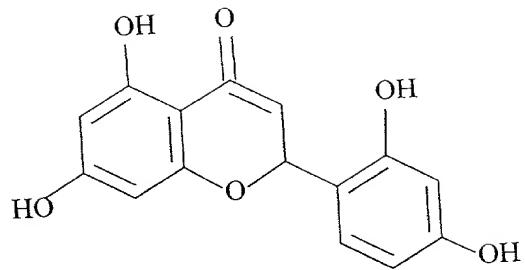


and others;

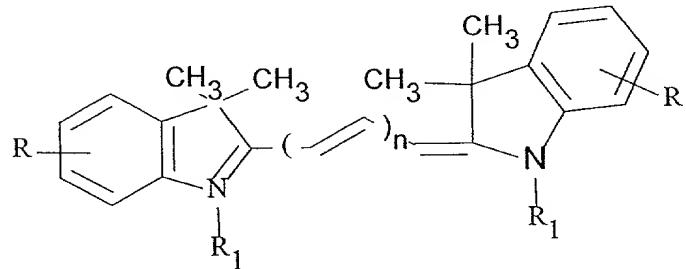
and dyes which are forming both the luminescent and non-luminescent complexes with polyvalent metal ions, selected from the hydroxyantraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:



Where R is CH<sub>3</sub>, CH<sub>2</sub>COOH,



and the cyanine dyes of the following structure:



wherein n is 1,2,3 ; R is H, SO<sub>3</sub>H and others; R<sub>1</sub> is alkyl, (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H and others m is 3,4 or

5 and  $X^-$  is a anion.

5. A method for making a luminescent material for an optical memory device comprising the steps of:
  - synthesizing silver halide salts;
  - applying a photographic emulsion comprising microcrystals of the silver halide salts and a water soluble polymer to a substrate to form a photoplate;
  - exposing said photoplate to light;
  - developing and fixation of said photoplate with formation of silver particles in the places which were exposed by the light;
  - oxidation of silver to form nonsoluble salts particles; and
  - treating the photoplate with a luminescing dye and allowing the luminescing dye to be sorbed onto the particles.

6. The method of claim 5, wherein the silver halide is selected from AgCl, AgBr, AgI, AgCl(Br), AgCl(Br,I) and AgBr(I).

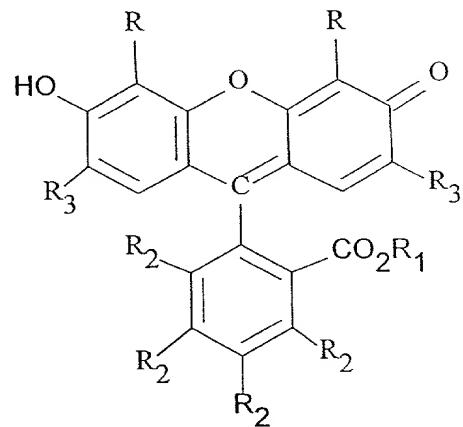
7. The method of claim 5, wherein the microcrystals of silver halide are less than about 0.2 microns.

8. The method of claim 7, wherein the microcrystals are about 0.02 to 0.08 microns.

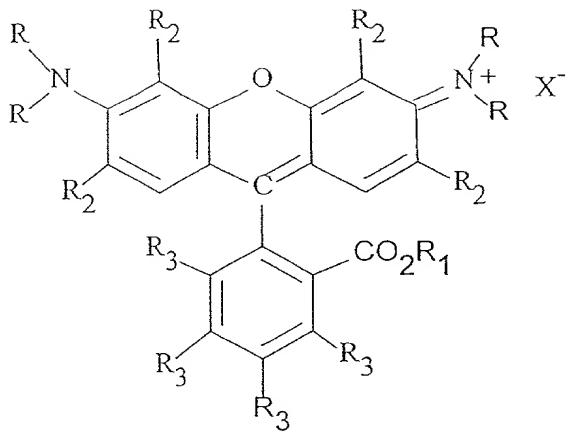
9. The method of claim 5, wherein the water soluble polymer is selected from the group consisting of polyvinyl alcohol, polyvinyl pyrrolidone, gelatine, gelatine modified with polyvinyl alcohol, polyvinyl pyrrolidone, polyvinyl sulphate, carboxymethylcellulose, cellulose acetophthalate, phthaloylgelatine or graft polymers of gelatine with polymethoxydiethyleneglycol acrylate, polydiacetoneacrylamide or poly-N,N'-methylenediacrylamide, and mixtures thereof.

10. The method of claim 5, wherein the luminescent dye is selected from the group consisting of

the xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of the following structure:

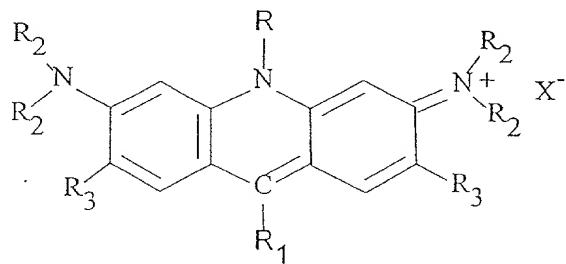


wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl and others; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate, alkyl and others; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub>, alkyl and others; the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



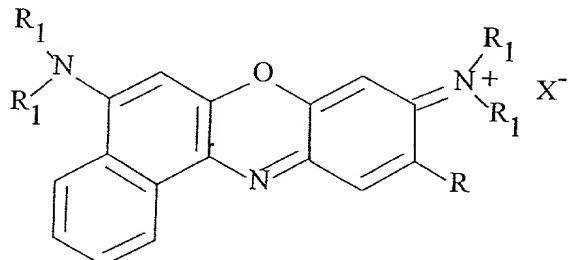
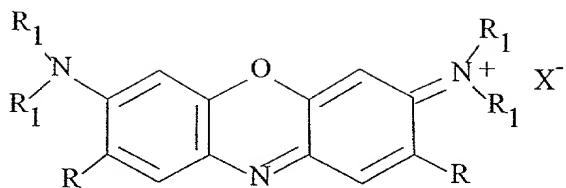
wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypaflovine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub>, alkyl and others; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

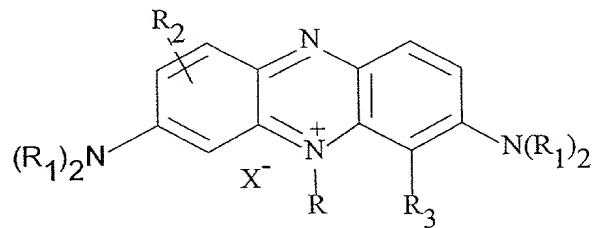
The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub>

and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

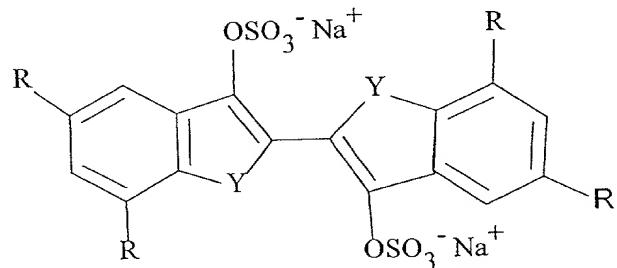
the azine dyes, including magdala red, lactoflavine and others having the following structure:



wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl;

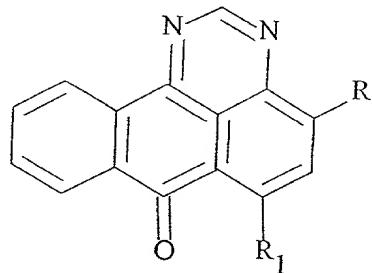
R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

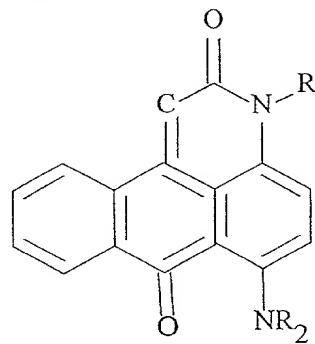


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

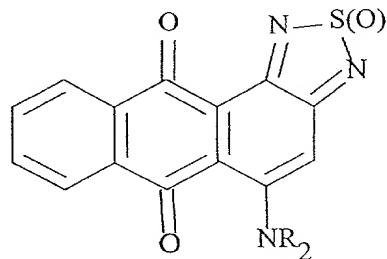
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoanthroquinones, dyes from the group of benzanthrone in the form of sulfuric esters of leuco compounds having the following structures:



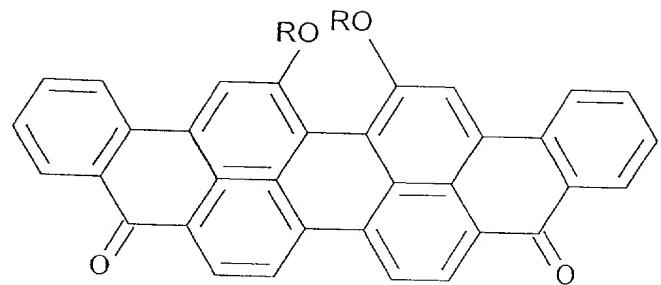
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



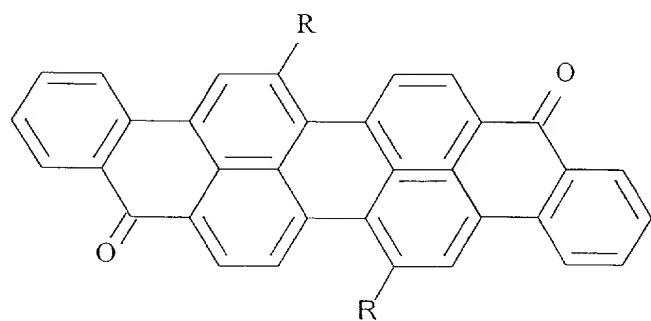
where R is H, alkyl, or aromatic,



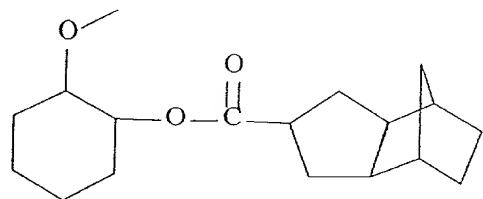
where R is H, C<sub>6</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



where R is H, Ar,  $\text{-SO}_2\text{Ar}$  and others.



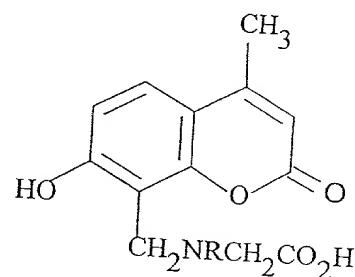
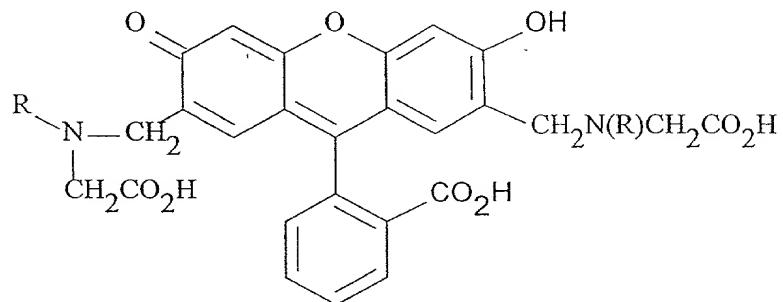
where R is independently selected from H, Cl, Br, OH, the structure:



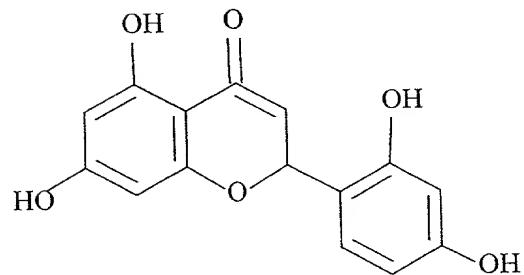
and others;

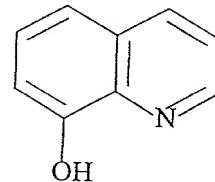
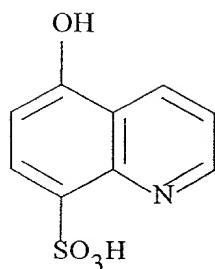
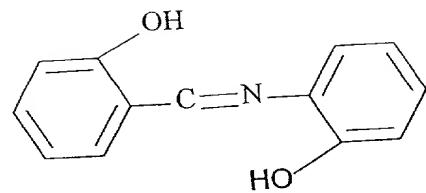
and dyes which are forming both the luminescent and non-luminescent complexes

with polyvalent metal ions, selected from the hydroxyantraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

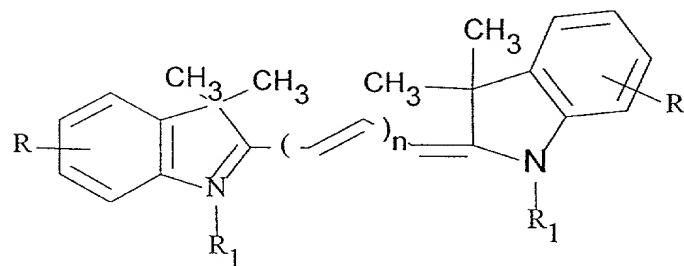


Where R is  $\text{CH}_3$ ,  $\text{CH}_2\text{COOH}$ ,





and the cyanine dyes of the following structure:



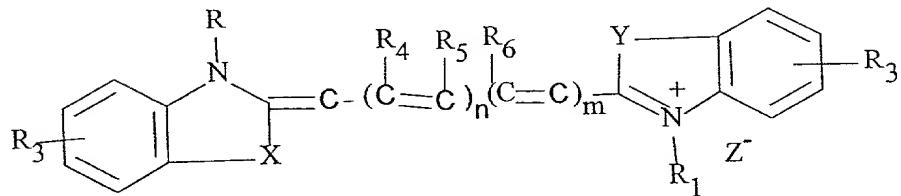
wherein n is 1,2,3 ; R is H, SO<sub>3</sub>H and others; R<sub>1</sub> is alkyl, (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H and others m is 3,4 or 5 and X<sup>-</sup> is a anion.

11. The method of claim 5, additionally comprising the step of increasing light sensitivity of the photographic emulsion by addition of a chemical sensitizer to the emulsion.

12. The method of claim 11, wherein the chemical sensitizer is selected from Na<sub>2</sub>SO<sub>3</sub>, thiourea, HAuCl<sub>4</sub>, AuCNS, SnCl<sub>2</sub>, dioxide of thiourea, borohydride and mixtures

thereof.

13. The method of claim 5, additionally comprising the step of adding a spectral sensitizer to the photoemulsion before applying to a substrate, said spectral sensitizer being selected from the group of sensitizers having the structure:



wherein for benzothiazole derivatives (X,Y=S); benzoxazole derivative (X,Y=O); benzimidazole derivative (X,Y=NR); quinoline derivative (X,Y=-CH=CH-); and indolenine derivative (X,Y=C(R<sub>2</sub>)) for the non-symmetrical dyes X does not equal Y (X≠Y), for example, X=O, and Y=S and are independently selected; wherein, for each derivative R<sub>2</sub> and R<sub>3</sub> are independently selected from H, CH<sub>3</sub>, -OCH<sub>3</sub>, -SCH<sub>3</sub>, -N(CH<sub>3</sub>)<sub>2</sub>, -N(Et)<sub>2</sub>, -N(propyl)<sub>2</sub>, -N(iso-propyl)<sub>2</sub>, -N(butyl)<sub>2</sub>, -N(iso-butyl)<sub>2</sub>, -N(sec-butyl)<sub>2</sub>, -NCO(CH<sub>2</sub>)<sub>k</sub>H wherein k is 1 to 5, F, Cl, Br, I, -CN, -CO<sub>2</sub>H, -CO<sub>2</sub>(CH<sub>2</sub>)<sub>j</sub>CH<sub>3</sub> where j is 0 to 4, -CONH<sub>2</sub>, -CF<sub>3</sub>, SOCF<sub>3</sub>, SO<sub>2</sub>CF<sub>3</sub>, -C<sub>6</sub>H<sub>5</sub>, and benzyl;

n is 0, 1 or 2 and m is 0 or 1;

when n is 0 and m is 1 then R<sub>6</sub> is independently selected from H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>6</sub>H<sub>5</sub>, NH<sub>2</sub>, -NHCOCH<sub>3</sub>, -OCH<sub>3</sub>, CO<sub>2</sub>CH<sub>3</sub>;

when n is 1 and m is 1 then R<sub>4</sub> and R<sub>6</sub> are H and R<sub>5</sub> H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, NHCOCH<sub>3</sub>;

when R<sub>4</sub> and R<sub>6</sub> are linked together and R<sub>4</sub> and R<sub>6</sub> are -(CH<sub>2</sub>)<sub>2</sub>- , -(CH<sub>2</sub>)<sub>3</sub>- , or -CH<sub>2</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>- then R<sub>5</sub> is H, Cl, and C<sub>6</sub>H<sub>5</sub>;

when n is 2 and m is 1 then R<sub>4</sub> ;

when R<sub>5</sub> and R<sub>6</sub> are H or R<sub>4</sub> and R<sub>6</sub> are H and R<sub>5</sub> and R<sub>5</sub> is linked together then R<sub>5</sub> is -

(CH<sub>2</sub>)<sub>3</sub><sup>-</sup>, -CH<sub>2</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub><sup>-</sup> ;

and when R and R<sub>1</sub> are independently selected from alkyl then Z<sup>-</sup> is an anion and when R and R<sub>1</sub> are independently selected from -(CH<sub>2</sub>)<sub>3</sub>SO<sub>3</sub><sup>-</sup> then Z<sup>+</sup> is a cation and mixtures therof.

14. The method of claim 5, additionally comprising the step of oxidation of the silver particles.

15. The method of claim 14, wherein the oxidizer for the silver particles is selected from K<sub>3</sub>[Fe(CN)<sub>6</sub>], (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>, KMnO<sub>4</sub>, CuCl<sub>2</sub>, FeCl<sub>3</sub>, and quinones.

16. The method of claim 14, wherein oxidation of silver particles is carried out in presence of the water soluble salts containing anions thereby forming insoluble silver salts.

17. The method of claim 16, wherein the water soluble salts contain anions selected from SCN<sup>-</sup>, CN<sup>-</sup>, Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>, WO<sub>4</sub><sup>2-</sup>, [Fe(CN)<sub>6</sub>]<sup>4-</sup> oxalate, citrate and from anions of 1-phenyl-5-mercaptotetrazole, 2-mercapto-benzothiazole, 2-mercaptopbenzoxazole, 2-mercaptobenzimidazole and organic mercapto compounds.

18. The method of claim 14, additionally comprising the step of adding a solution of at least one multivalent cation to the photoplate after the surface of the silver particles is oxidized to form a non-silver insoluble salt.

19. The method of claim 18, wherein the multivalent cations are selected from the group consisting of  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Ba^{2+}$  and  $Co^{2+}$ .

20. The method of claim 14, additionally comprising the step of adsorption on the insoluble silver or non-silver salts at least one multivalent cation forming a metallo-complex luminescence compounds.

21. The method of claim 18, additionally comprising the step of adsorption on the insoluble silver or non-silver salts at least one multivalent cation forming a metallo-complex luminescence compounds.

22. A method of claim 16, wherein the multivalent cations are selected from the group consisting of  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Sr^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Fe^{3+}$ ,  $Cr^{3+}$ ,  $In^{3+}$ ,  $Bi^{3+}$ ,  $La^{3+}$ ,  $Gd^{3+}$ ,  $V^{4+}$ ,  $Ce^{4+}$ , and  $Th^{4+}$ .

23. The method of claim 15, wherein the insoluble silver and non-silver salts have a solubility product less than about  $10^{-8}$  at  $25^{\circ}C$ .

24. The method of claim 23, wherein the solubility product is less than  $10^{-8}$  at  $25^{\circ}C$ .

25. The method of claim 18, wherein the insoluble silver and non-silver salts have a solubility product less than about  $10^{-8}$  at  $25^{\circ}C$ .

26. The method of claim 20, wherein the insoluble silver and non-silver salts have a solubility product less than about  $10^{-8}$  at 25°C.

27. The luminescent optical memory material made by the process comprising the steps of:

applying a photographic emulsion comprising microcrystals of silver halide salts and a water soluble polymer to a substrate to form a photoplate;

exposing said photoplate to light;

developing and fixation of the photoplate to form silver particles from the exposed silver halide;

treating the photoplate with a luminescing dye and allowing the luminescing dye to be sorbed onto the particles.

28. The luminescent optical memory material of claim 27, wherein the silver halide is selected from AgCl, AgBr, AgI, AgCl(Br), AgCl(Br,I) and AgBr(I).

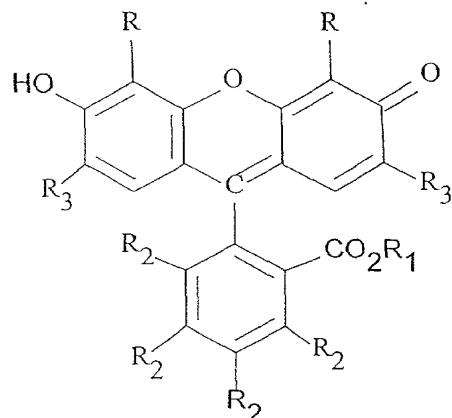
29. The luminescent optical memory material of claim 27, wherein the microcrystals of silver liquid are less than about 0.2 microns.

30. The luminescent optical memory material of claim 29, wherein the microcrystals are about 0.02 to 0.08 microns.

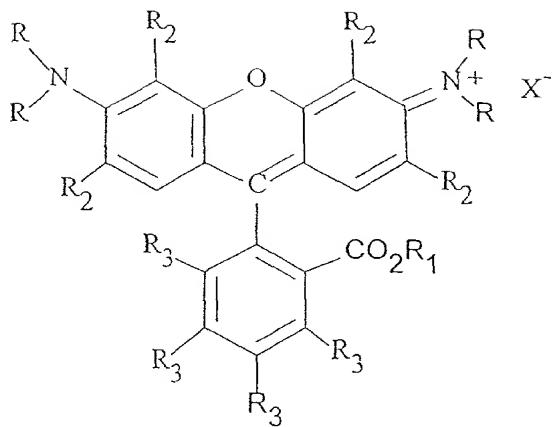
31. The luminescent optical memory material of claim 27, wherein the water

soluble polymer is selected from the group consisting of polyvinyl alcohol, polyvinyl pyrrolidone, gelatine, gelatine modified with polyvinyl alcohol, polyvinyl pyrrolidone, polyvinyl sulphate, carboxymethylcellulose, cellulose acetophthalate, phthaloylgelatine or graft polymers of gelatine with polymethoxydiethyleneglycol acrylate, polydiacetoneacrylamide or poly-N,N'-methylenediacrylamide, and mixtures thereof.

32. The luminescent optical memory material of claim 27, wherein the luminescent dye is selected from the group consisting of the xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of the following structure:

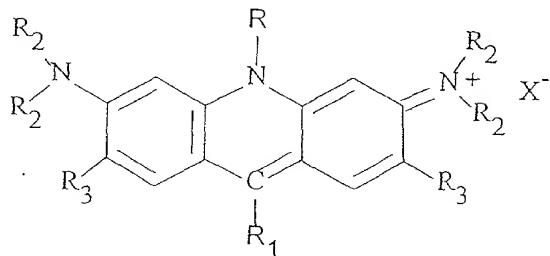


wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl and others; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate, alkyl and others; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub>, alkyl and others; the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



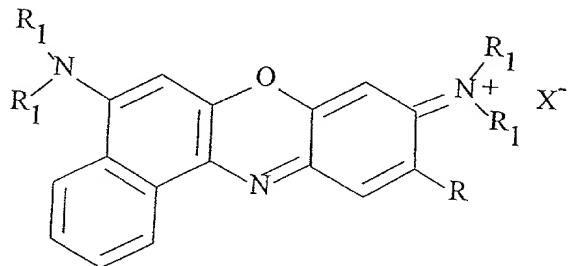
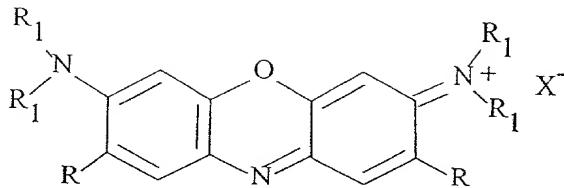
wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypafloxine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub>, alkyl and others; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

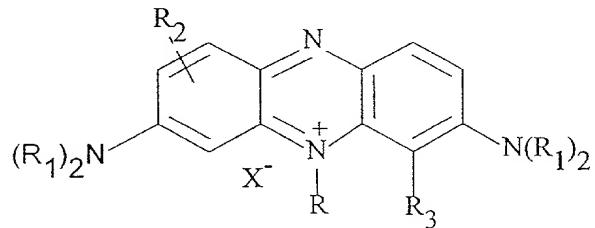
The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub>

and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

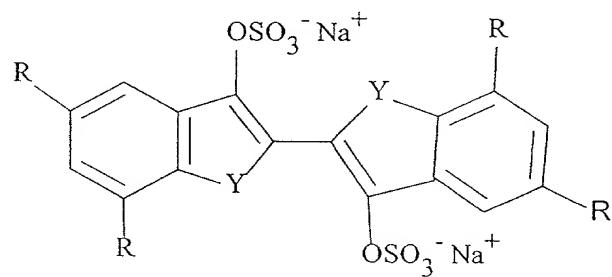
the azine dyes, including magdala red, lactoflavine, and others having the following structure:



wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl;

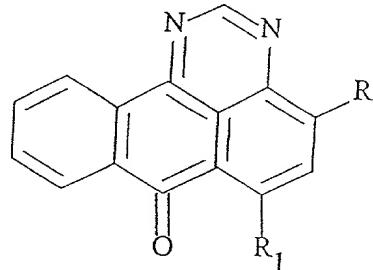
R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

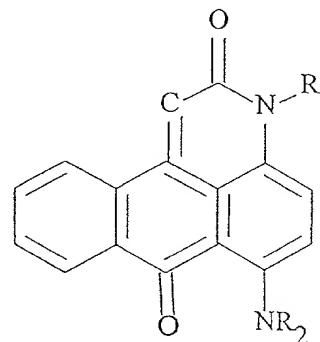


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

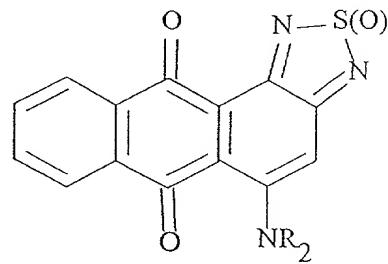
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoantroquinones, dyes from the group of benzanthrone in the form of sulfuric esters of leuco compounds having the following structures:



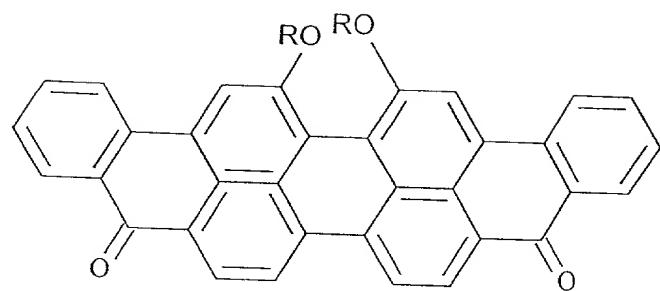
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



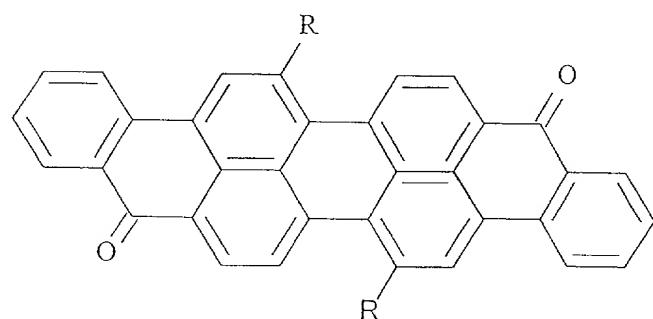
where R is H, alkyl, or aromatic,



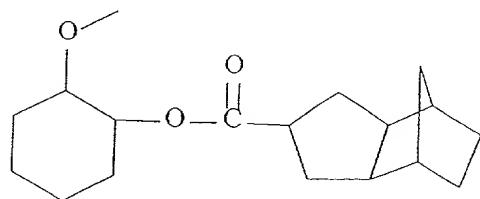
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



where R is H, Ar, -SO<sub>2</sub>Ar and others,



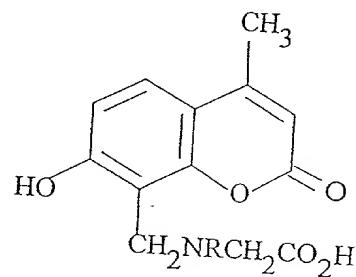
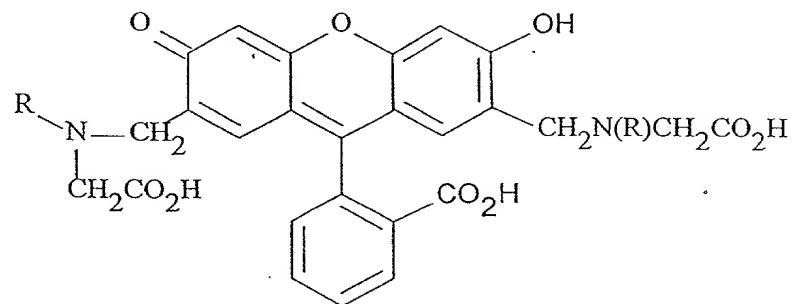
where R is independently selected from H, Cl, Br, OH, the structure:



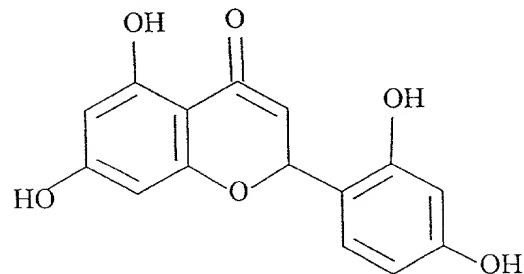
and others;

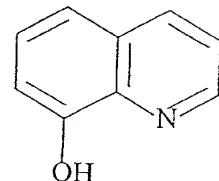
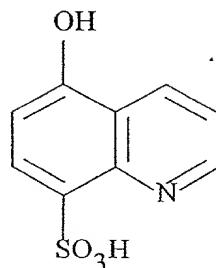
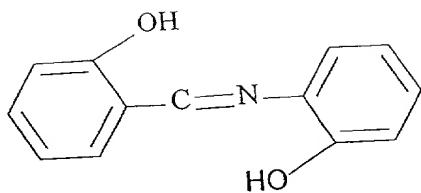
and dyes which are forming both the luminescent and non-luminescent complexes

with polyvalent metal ions, selected from the hydroxyantraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

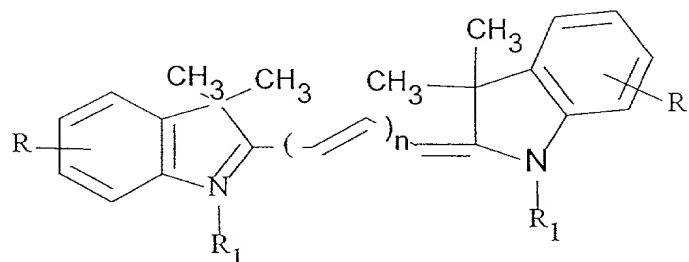


Where R is  $\text{CH}_3$ ,  $\text{CH}_2\text{COOH}$ ,





and the cyanine dyes of the following structure:



wherein n is 1,2,3 ; R is H, SO<sub>3</sub>H and others; R<sub>1</sub> is alkyl, (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H and others m is 3,4 or 5 and X<sup>-</sup> is a anion.

33. The luminescent optical memory material of claim 27, additionally comprising the step of adding a spectral sensitizer to the photoplate before exposure to light, said spectral sensitizer being selected from the group of sensitizers shown below and mixtures thereof.

34. The luminescent optical memory material of claim 27, additionally comprising

the step of oxidizing the surface of the silver particles in the photoplate.

35. The luminescent optical memory material of claim 34, additionally comprising the step of adding a solution of at least one multivalent ion to the photoplate after the surface of the silver particles is oxidized.

36. The luminescent optical memory material of claim 35, wherein the multivalent ions are selected from the group consisting of  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Ba^{2+}$  and  $Co^{2+}$ .

37. The luminescent optical memory material of claim 36, additionally comprising the step of treating the oxidized silver particles with metal salts to form insoluble metal complexes.

38. The luminescent optical memory material of claim 37, wherein the metal salts are selected from the group consisting of  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Sr^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Fe^{3+}$ ,  $Cr^{3+}$ ,  $In^{3+}$ ,  $Bi^{3+}$ ,  $La^{3+}$ ,  $Gd^{3+}$ ,  $V^{4+}$ ,  $Cl^{4+}$ ,  $Th^{4+}$ , and mixtures thereof.

39. The luminescent optical memory material of claim 35, wherein the insoluble metal complexes have a solubility constant less than about  $10^{-8}$  at  $25^{\circ}C$ .

40. The luminescent optical memory material of claim 39, wherein the solubility constant is less than  $10^{-8}$  at  $25^{\circ}C$ .

41. The method of claim 5, wherein the photographic emulsion is applied to the base so that there are layers of photographic emulsion separated by layers of a water soluble polymer.

42. The luminescent optical memory material of claim 27, wherein the photographic emulsion is applied to the base so that there are layers of photographic emulsion separated by layers of a water soluble polymer.

43. The luminescent optical memory material of claim 37, wherein the insoluble silver and non-silver salts and metal complexes have a solubility product less than about  $10^{-8}$  at 25°C.

44. The luminescent optical memory material of claim 43, wherein the solubility product is less than  $10^{-8}$  at 25°C.

45. The method for making a multi-layer luminescent material for a three-dimensional optical memory device comprising the steps of:

obtaining identical one-layered photoplates according to claim 5;  
sequential stacking the one-layered photoplates to form the multi-layer material, in which the active luminescent layers are separated by the polymeric substrate.

46. The method of claim 45, wherein the number of the active luminescent layers is from two to twenty.

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47. A method for making a multi-layer luminescent material for a three-dimensional optical memory comprising the steps of:

simultaneous extruding from a multi-slit filler thin layers of photographic emulsion and between them thick layers of a silver halide free polymer to a substrate;

exposing said multi-layer material to light;

developing and fixation of said multi-layer material to form silver particles from the exposed silver halide;

oxidation of silver particles to form the insoluble salt particles;

treating the photoplate with luminescing dye and allowing the luminescing dye to be sorbed onto the particles.

48. The method of claim 47, wherein the number of the active luminescent layers is from two to twenty.

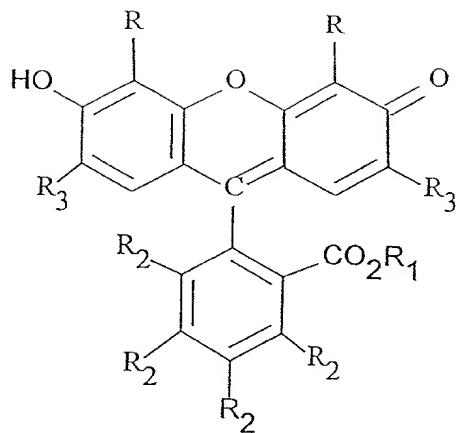
49. The method of claim 47, wherein the separate photographic emulsion layers are spectrally sensitized.

50. The method of claim 47, wherein the separated photographic emulsion layers are spectrally sensitized to different parts of the visible and infrared range of spectrum.

51. The luminescent optical memory material of claim 34, wherein the luminescent dyes are selected from:

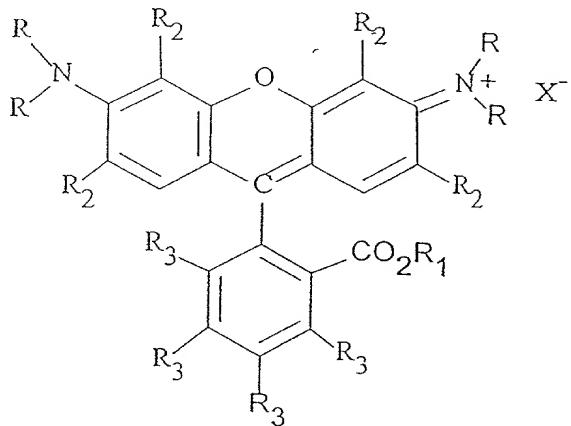
the xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein

the following structure:



wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub> and alkyl; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate and alkyl; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub> and alkyl;

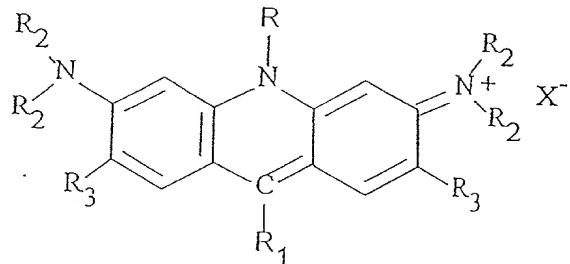
the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>

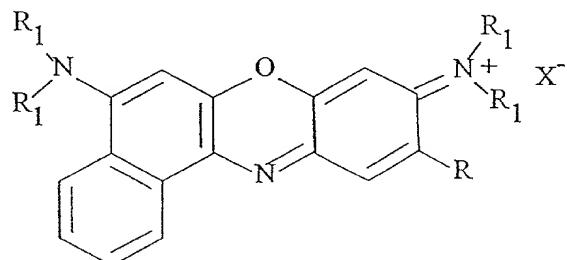
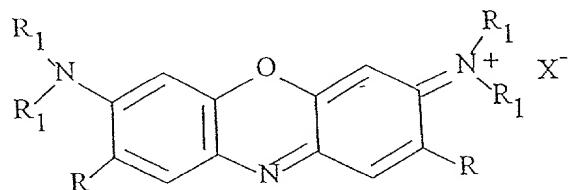
, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypaflovine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub> and alkyl; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

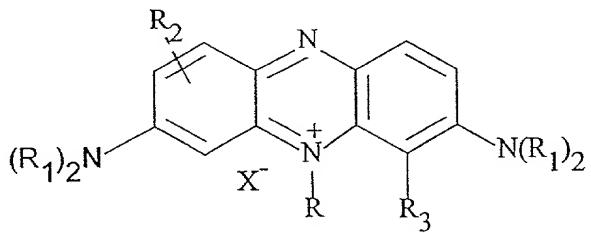
The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub> and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

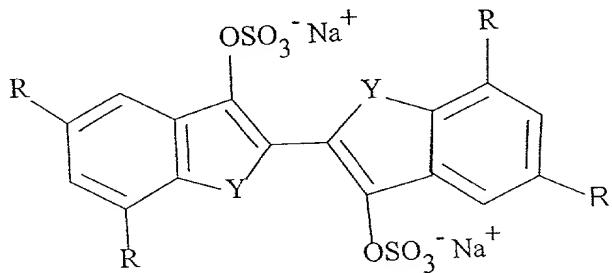
the azine dyes, including magdala red, lactoflavine. and others having the following

structure:



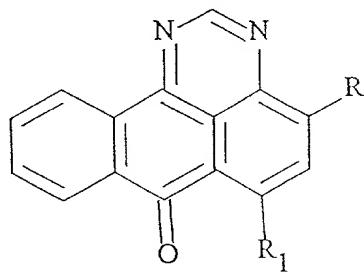
wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl; R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

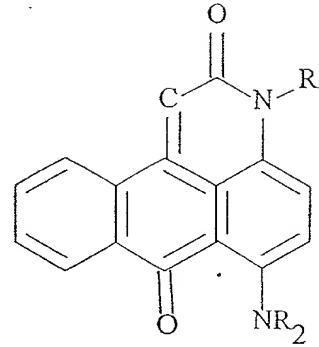


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

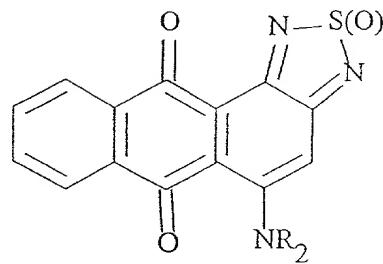
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoantroquinones, dyes from the group of benzanthrone in the form of sulfuric esters of leuco compounds having the following structures:



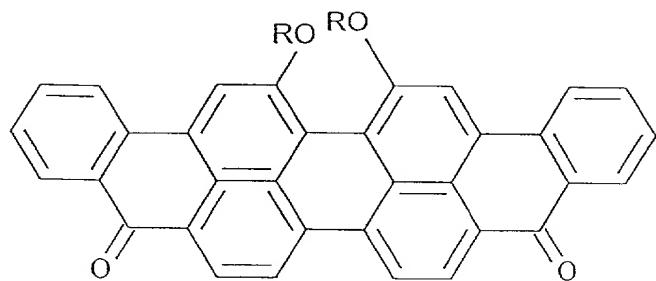
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



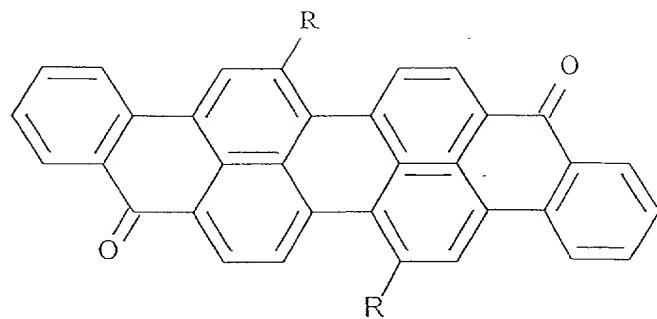
where R is H, alkyl, or aromatic,



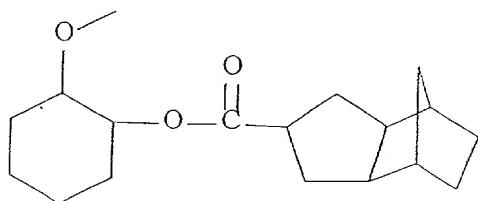
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



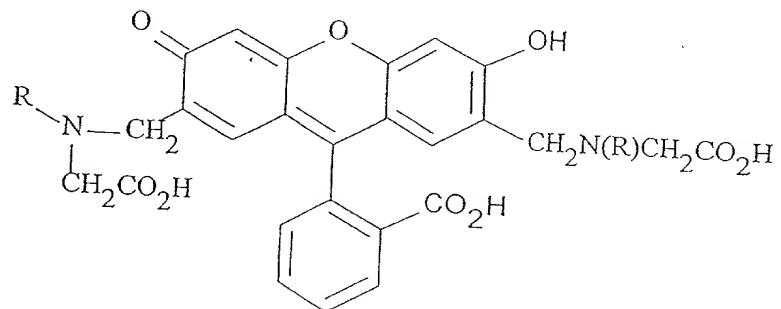
where R is H, Ar and  $\text{-SO}_2\text{Ar}$ ,

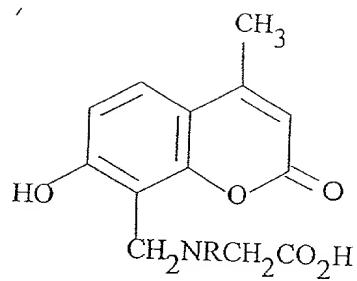


where R is independently selected from H, Cl, Br, OH and the structure:

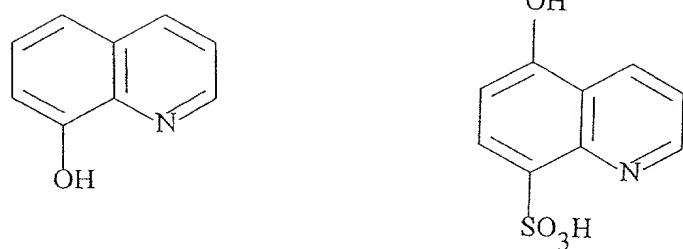
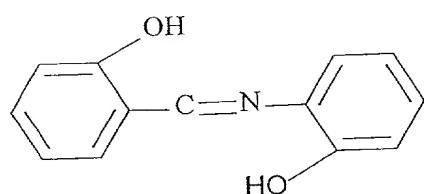
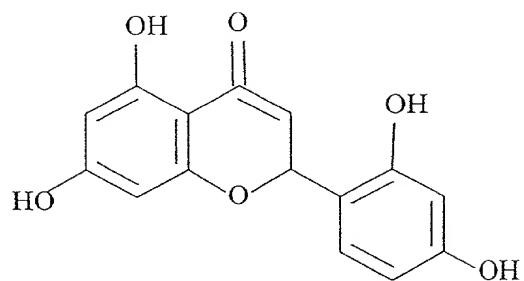


and dyes which are forming both the luminescent and non-luminescent complexes with polyvalent metal ions, selected from the hydroxyanthraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

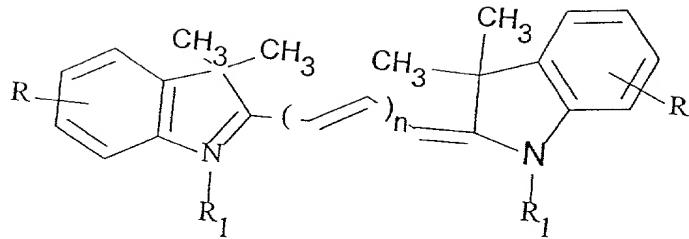




Where R is  $\text{CH}_3$ ,  $\text{CH}_2\text{COOH}$ ,



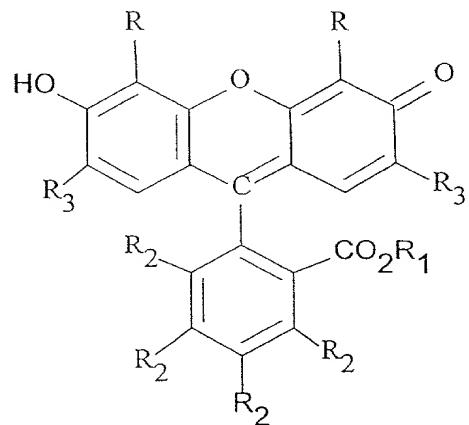
and the cyanine dyes of the following structure:



wherein n is 1,2,3 ; R is H and SO<sub>3</sub>H; R<sub>1</sub> is alkyl and (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H m is 3,4 or 5 and X<sup>-</sup> is a anion.

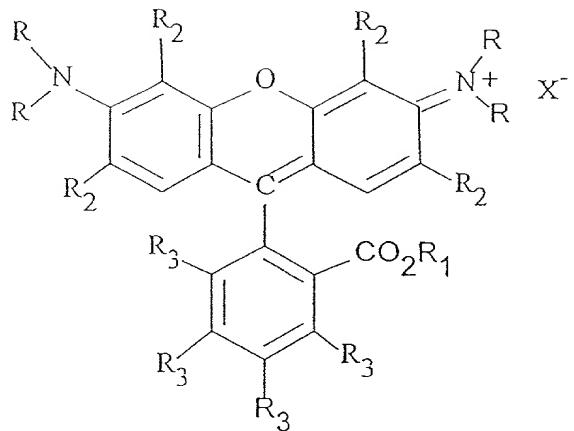
52. The luminescent optical memory material of claim 35 wherein the luminescent dyes are selected from the group:

- xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of the following structure:



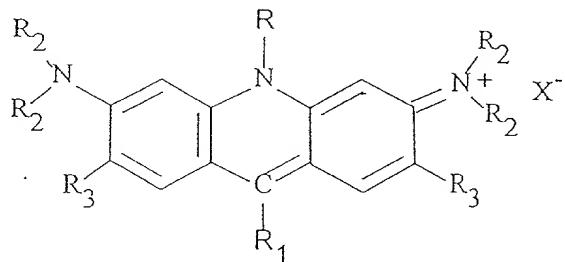
wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub> and alkyl ; R<sub>1</sub> is H, Na, K, alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate and alkyl and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub>, and alkyl;

the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



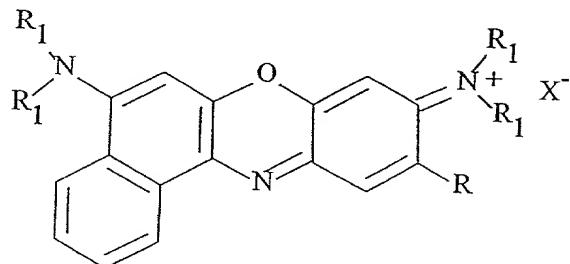
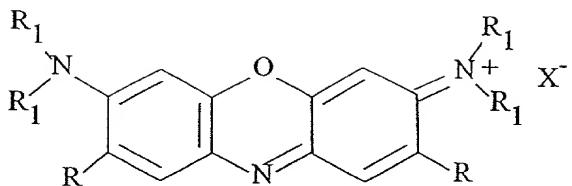
wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypaflovine, ethoxydiaminoacridine lactate and others having the following structure:

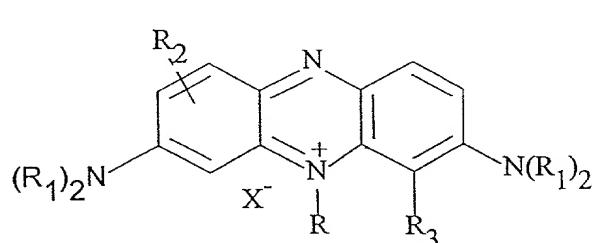


wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub> and alkyl ; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:

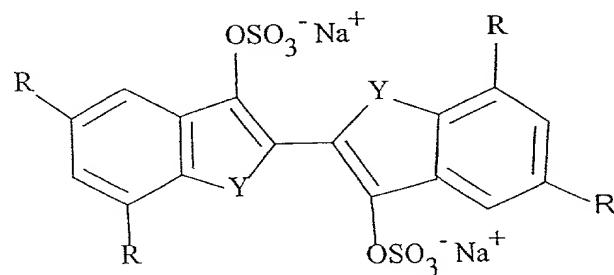


where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub> and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates; the azine dyes, including magdala red, lactoflavine and others having the following structure:



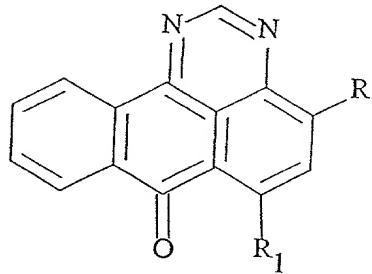
wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl; R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

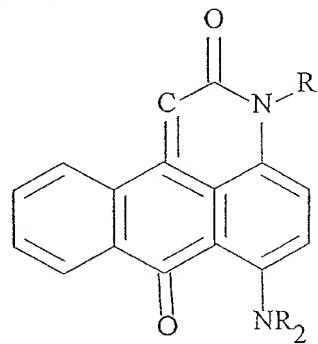


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

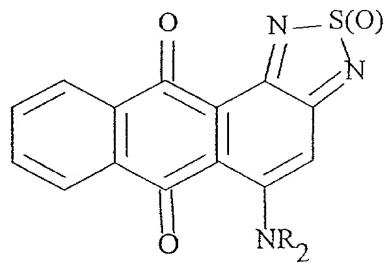
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoanthroquinones, dyes from the group of benzanthrone in the form of sulfuric esters of leuco compounds having the following structures:



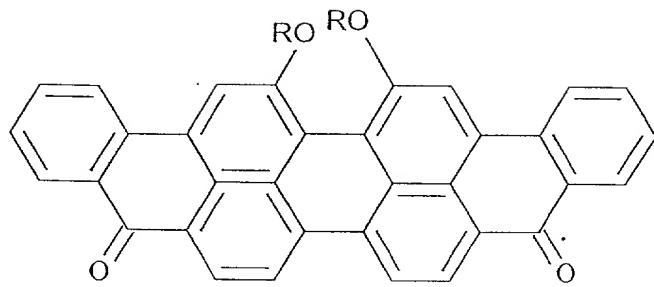
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



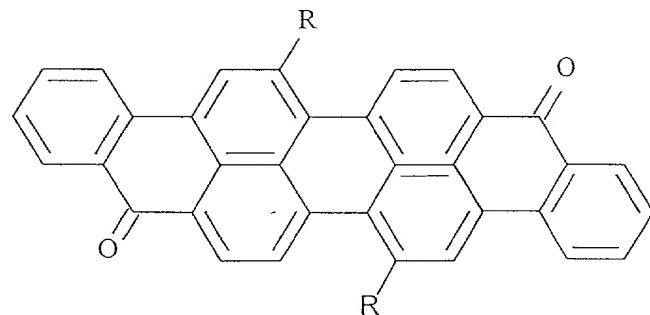
where R is H, alkyl, or aromatic,



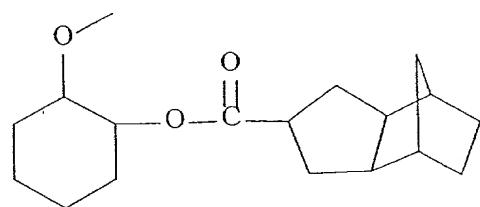
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



where R is H, Ar and -SO<sub>2</sub>Ar ,

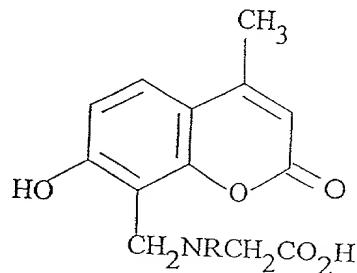
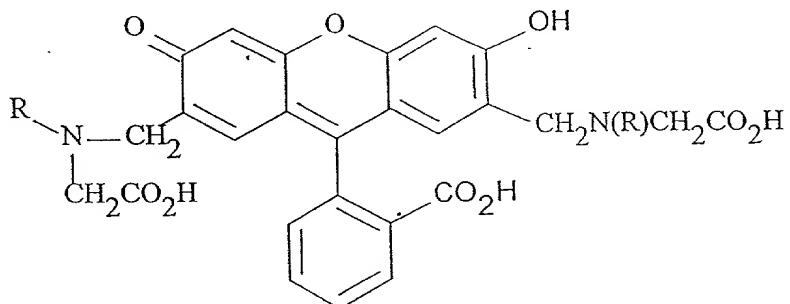


where R is independently selected from H, Cl, Br, OH, and the structure:

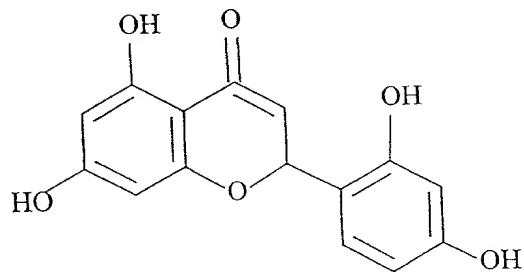


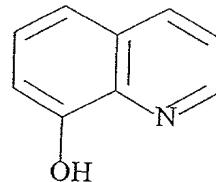
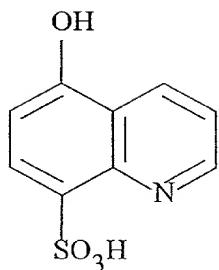
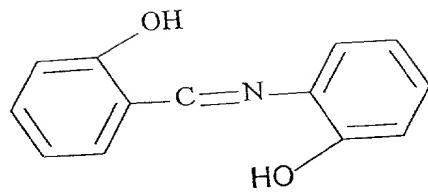
and dyes which are forming both the luminescent and non-luminescent complexes

with polyvalent metal ions, selected from the hydroxyantraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

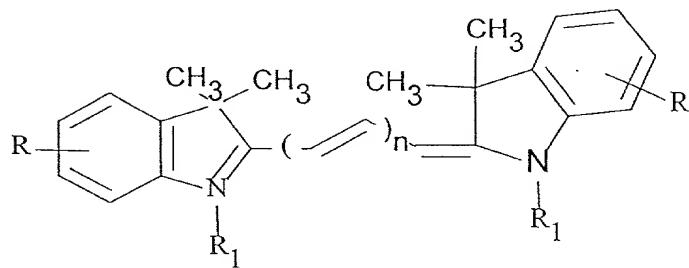


Where R is  $\text{CH}_3$ ,  $\text{CH}_2\text{COOH}$ ,





and the cyanine dyes of the following structure:

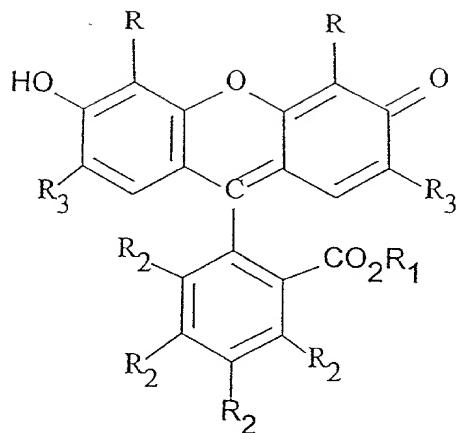


wherein n is 1,2,3 ; R is H and SO<sub>3</sub>H; R<sub>1</sub> is alkyl and (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H ; m is 3,4 or 5 and X<sup>-</sup> is an anion.

53. The method of claim 18, wherein the luminescent dye is selected from the group:

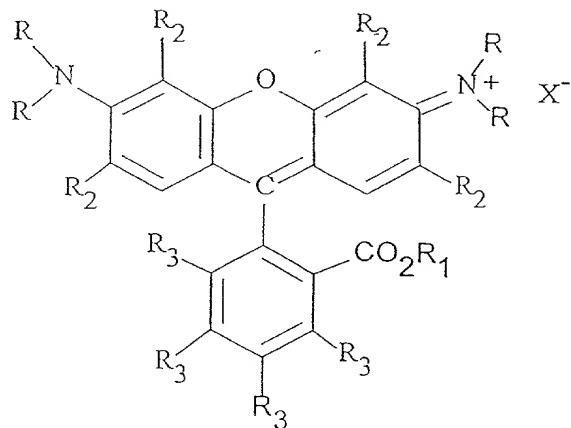
xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of

the following structure:



wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub> and alkyl; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate and alkyl; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub> and alkyl;

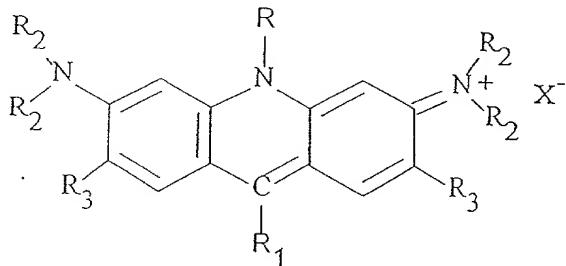
the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the following structure:



wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>

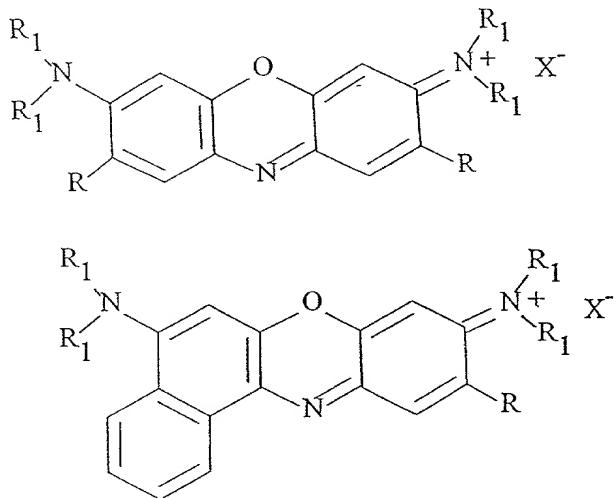
, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypaflovine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub> and alkyl; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

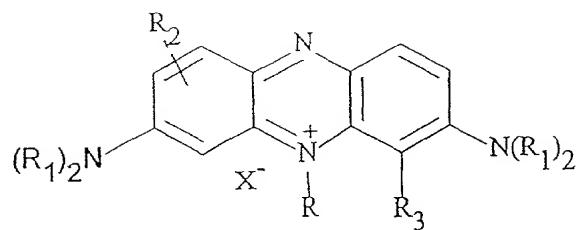
The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub> and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

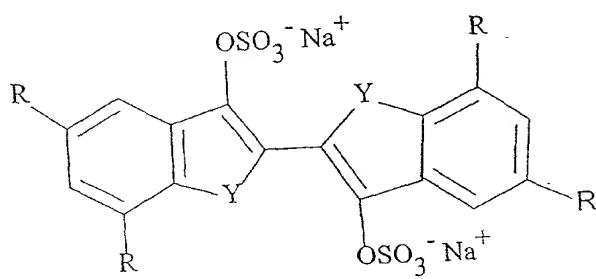
the azine dyes, including magdala red, lactoflavine. and others having the following

structure:



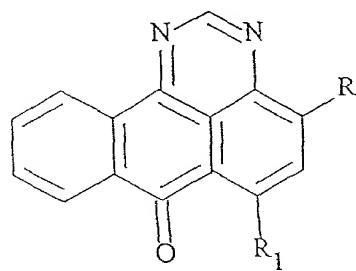
wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>, R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl; R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

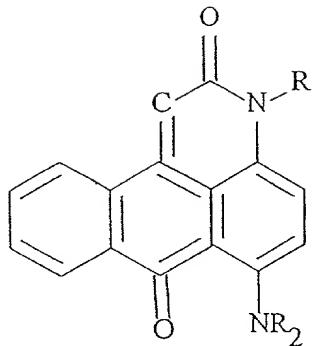


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

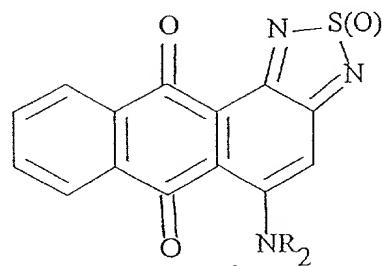
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoantroquinones, dyes from the group of benzanthones in the form of sulfuric esters of leuco compounds having the following structures:



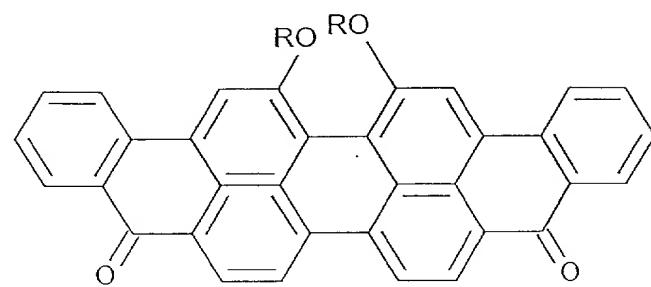
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



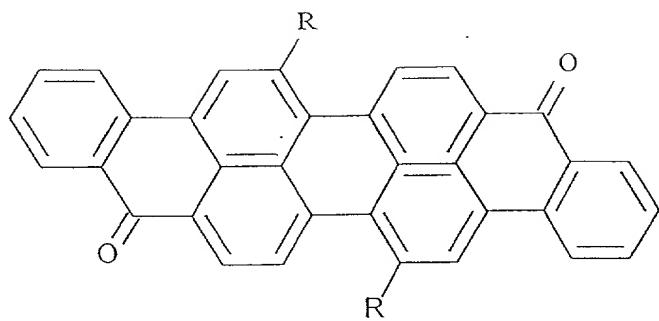
where R is H, alkyl, or aromatic,



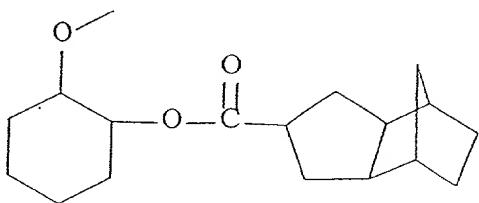
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



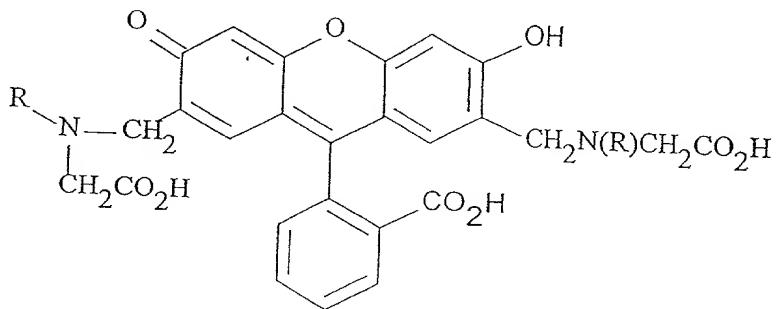
where R is H, Ar and  $\text{-SO}_2\text{Ar}$ ,

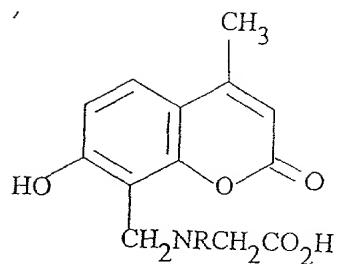


where R is independently selected from H, Cl, Br, OH and the structure:

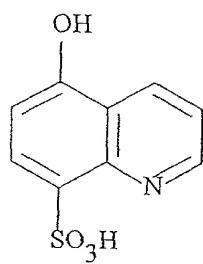
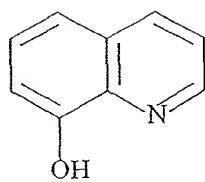
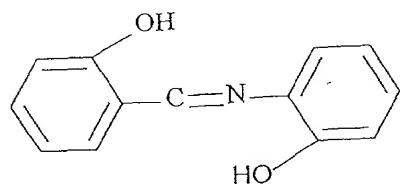
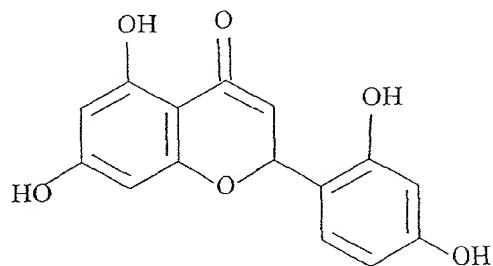


and dyes which are forming both the luminescent and non-luminescent complexes with polyvalent metal ions, selected from the hydroxyanthraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

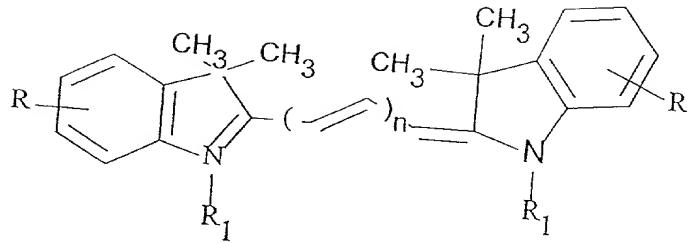




Where R is  $\text{CH}_3$ ,  $\text{CH}_2\text{COOH}$ ,



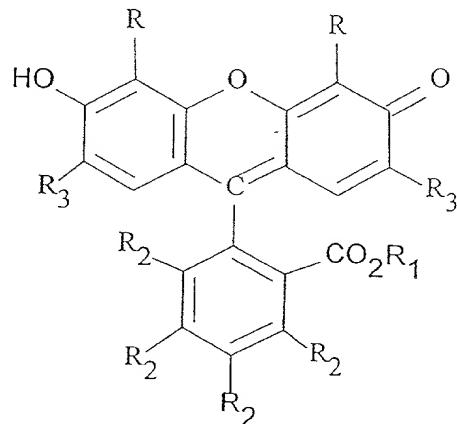
and the cyanine dyes of the following structure:



wherein n is 1,2,3 ; R is H and SO<sub>3</sub>H; R<sub>1</sub> is alkyl, and (CH<sub>2</sub>)<sub>m</sub>SO<sub>3</sub>H m is 3,4 or 5 and X<sup>-</sup> is a anion.

54. The method of claim 20, wherein the luminescent dye is selected from the group:

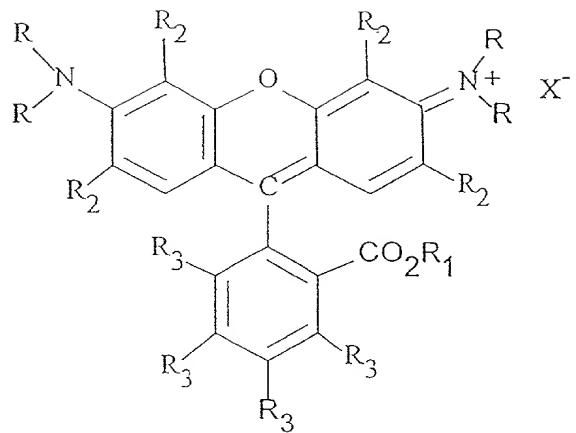
xanthene dyes including eosins, fluoresceins, erythrosins, and dichlorofluorescein of the following structure:



wherein R is independently selected from H, Cl, Br, I, NO<sub>2</sub> and alkyl; R<sub>1</sub> is H, Na, K, Alkyl; R<sub>2</sub> is independently selected from H, Cl, NH<sub>2</sub>, Br, I, isocyanate, isothiocyanate and alkyl; and R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, NH<sub>2</sub> and alkyl;

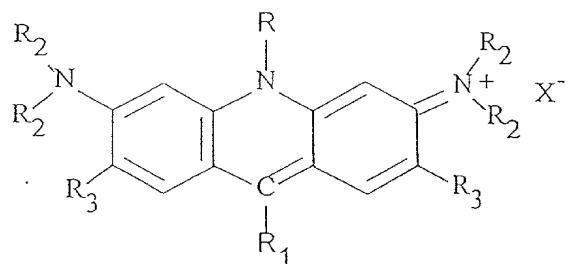
the xanthene dyes including the rhodamines B, 3B, C, G, 6G, 101, 123 having the

following structure:



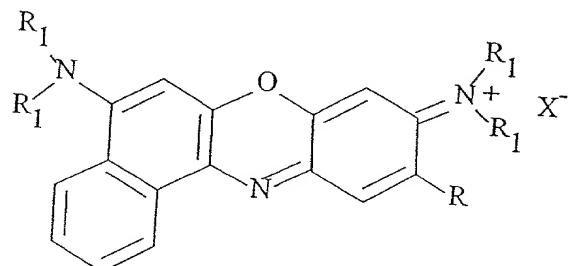
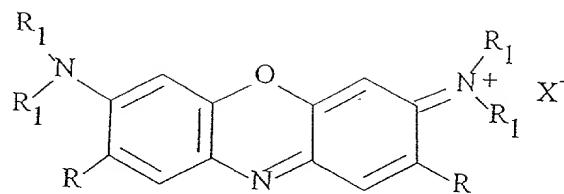
wherein R is H, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, CH<sub>2</sub>COOH, C<sub>2</sub>H<sub>4</sub>OH; R<sub>1</sub> is H, Na, K, CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, Ar, and alkyl; R<sub>2</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, alkyl; R<sub>3</sub> is independently selected from H, Cl, Br, I, NO<sub>2</sub>, isothiocyanate, isocyanate, amines and X is an anion selected from Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

the acridine dyes, including aurazine, trypaflovine, ethoxydiaminoacridine lactate and others having the following structure:



wherein R is H, CH<sub>3</sub>, and C<sub>2</sub>H<sub>5</sub>, R<sub>1</sub> is independently selected from H, C<sub>6</sub>H<sub>5</sub>, and CO<sub>2</sub>H, R<sub>2</sub> is independently selected from H, CH<sub>2</sub>CH<sub>2</sub>OH, and alkyl, R<sub>3</sub> is independently selected from H, CH<sub>3</sub>, alkyl and others; and X is a anion of F, Cl, Br, I, HCOO<sup>-</sup>, CH<sub>3</sub>CHOHCOO<sup>-</sup>, and ClO<sub>4</sub><sup>-</sup>;

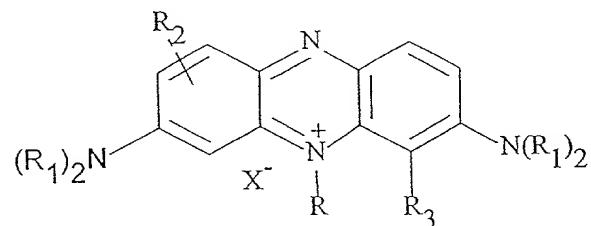
The oxazine dyes, including the oxazines 1, 4, 9, 17, 118, nile blue, capry blue A and others having the general structures:



where R is selected from H, and CH<sub>3</sub>, R<sub>1</sub> is independently selected from H, CH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub>

and alkyl and X is an anion selected from F, Cl, Br, I, ClO<sub>4</sub><sup>-</sup>, sulfates, and phosphates;

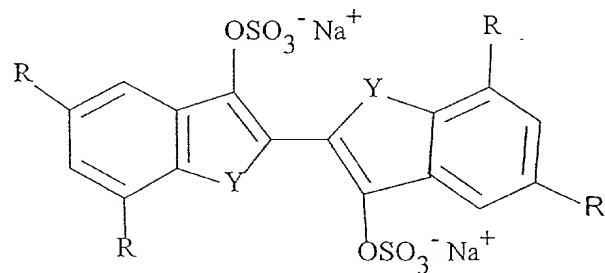
the azine dyes, including magdala red, lactoflavine, and others having the following structure:



wherein R is phenyl, naphthyl; R<sub>1</sub> is H, alkyl, and C<sub>6</sub>H<sub>5</sub>; R<sub>2</sub> is H, alkyl, benzyl, and O-benzyl;

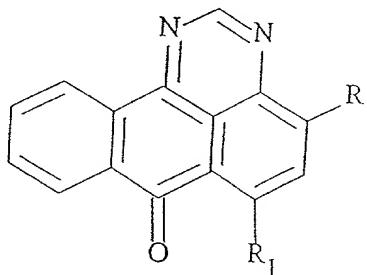
R<sub>3</sub> is H, and SO<sub>3</sub>H, and X is an anion;

the indigo dyes, in the form of indigozoles, having the following structure:

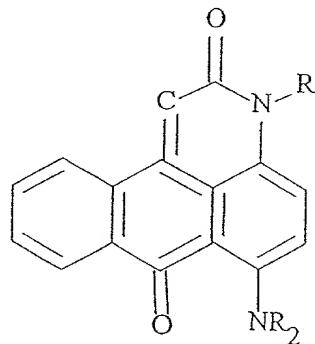


wherein, Y is NH, S and R is independently selected from H, Cl, Br, O-alkyl, NO<sub>2</sub>, sulfate, and alkyl;

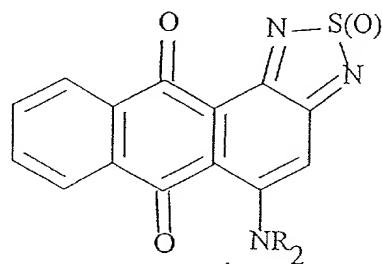
the polycyclic vat dyes, including aminoanthropyrimidines, anthropyridones, oxa-and tiadiazoloaminoantroquinones, dyes from the group of benzanthrones in the form of sulfuric esters of leuco compounds having the following structures:



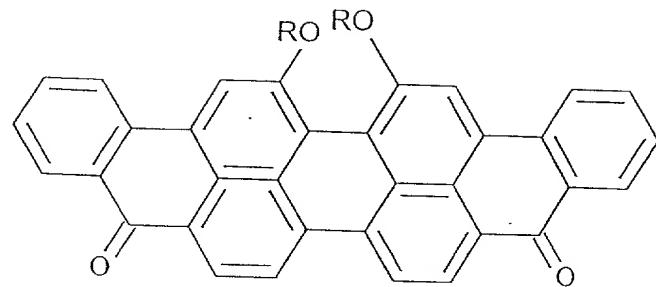
where R is H, NH-C<sub>6</sub>H<sub>5</sub>, R<sub>1</sub> is H, NHCOAr,



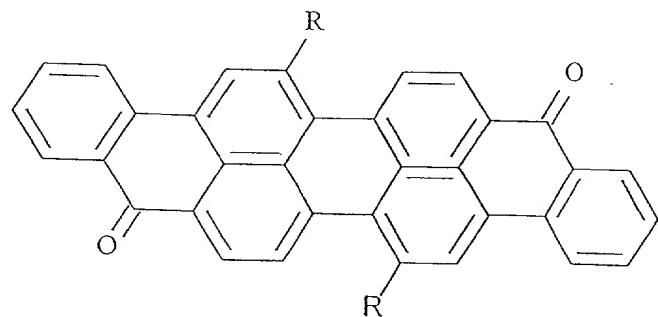
where R is H, alkyl, or aromatic,



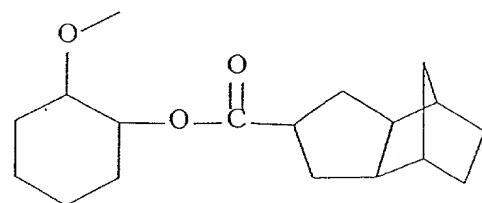
where R is H, C<sub>6</sub>H<sub>11</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>2</sub>H<sub>4</sub>OH,



where R is H, Ar and -SO<sub>2</sub>Ar ,

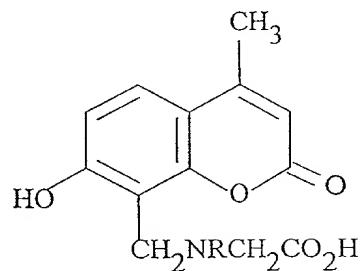
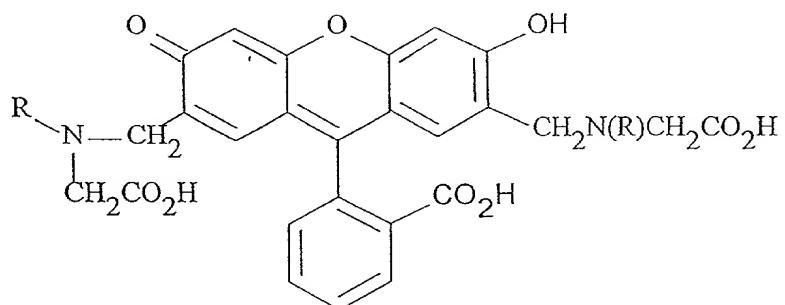


where R is independently selected from H, Cl, Br, OH and the structure:

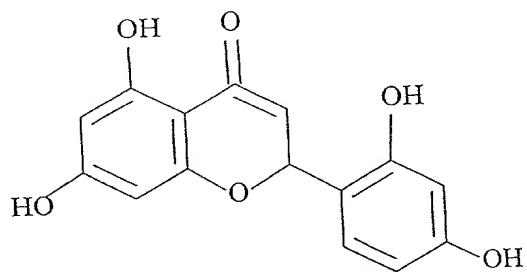


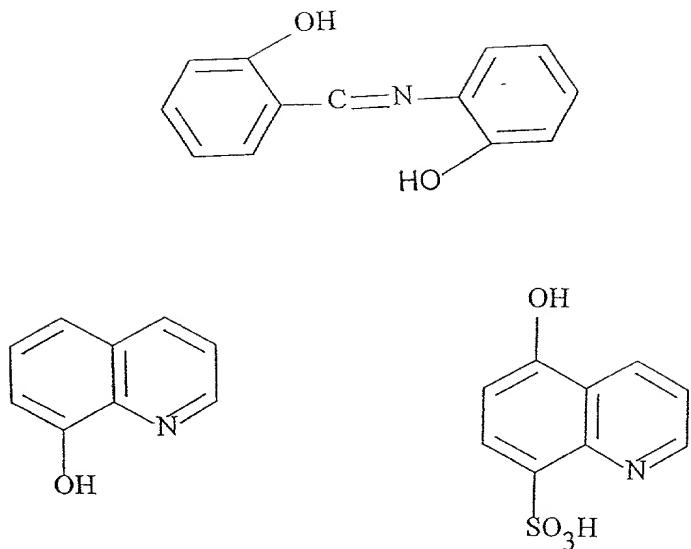
and dyes which are forming both the luminescent and non-luminescent complexes

with polyvalent metal ions, selected from the hydroxyantraquinone derivatives: calcein, calcein blue, xanthocomplexan, methylcalcein, methylcalcein blue as shown in the following structures:

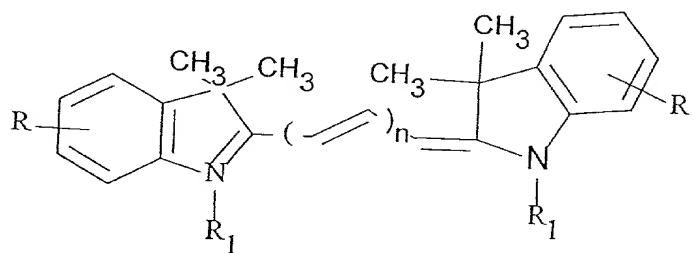


where R is CH<sub>3</sub>, CH<sub>2</sub>COOH,





and the cyanine dyes of the following structure:



wherein  $n$  is 1,2,3 ;  $R$  is H and  $\text{SO}_3\text{H}$ ;  $R_1$  is alkyl and  $(\text{CH}_2)_m\text{SO}_3\text{H}$   $m$  is 3,4 or 5 and  $X^-$  is a anion.